

CLAIMS

1. A method of evaluating the position of a time-varying disturbance on a transmission link, the method including the steps of: copying, at least in part, an output signal from a source, such that there is a pair of signal copies; transmitting the signal copies onto the transmission link; receiving from the transmission link at least partially returned signal copies previously transmitted thereon; combining the received signal copies of a transmitted pair so as to produce a combination signal; and, using a temporal characteristic in the combination signal to evaluate the position of the disturbance on the transmission link.
2. A method as claimed in claim 1, wherein the temporal characteristic includes the time at which a disturbance feature occurs in the combination signal.
3. A method as claimed in claim 1 or claim 2, wherein signal copies are returned by a process of distributed backscattering as the signal copies travel along the transmission link.
4. A method as claimed in claim 3, wherein the source is configured to produce output signals having the form of optical pulses, each optical pulse giving rise to a combination signal that is distributed over time as the pulse travels along the transmission link.
5. A method as claimed any of the preceding claims, wherein the combination signal is sampled at a first set of spaced apart temporal positions and at a second set of temporal position, and a wherein the first and second sampled sets are compared in a comparison step.
6. A method as claimed in claim 5, wherein the temporal positions of the first and second sets are interleaved.
7. A method as claimed in claim 5 or claim 6, wherein the comparison step involves generating a set of data which is at least in part dependent on the difference between the first and second sets.

8. A method as claimed in any of the preceding claims, wherein the signal copies are carried along a common transmission medium of the optical transmission link.
- 5 9. A method as claimed in any of the preceding claims, wherein signal copies of a pair travel along the transmission link with a differential delay relative to one another.
10. A method as claimed in claim 9, wherein the differential delay is caused at an unbalanced interferometer coupled to an optical source, the interferometer having a first
10 path and a second path, the transit time of the first path being longer than that of the second path, signal copies of a pair being caused to travel along a different respective path to one another.
11. A method as claimed in claim 10, wherein the interferometer has a first coupling
15 stage which is coupled to the source, the coupling stage being arranged to channel one portion of the incoming radiation intensity from the source along one path, and another portion of the incoming radiation intensity along the other path, so as to form the first and second signal copies.
- 20 12. A method as claimed in claim 11, wherein the interferometer has a second coupling stage for combining radiation from the first and second paths, and for coupling the combined radiation to the common communications link.
13. A method as claimed in claim 12, wherein the signals returned from the second
25 location are each channelled along the first and second paths by a second coupling stage, and wherein the so channelled signals are subsequently combined at the first coupling stage.
14. A method as claimed in any of the preceding claims, wherein the signal copies of
30 a pair are delayed relative to one another at a first location, and wherein a disturbance is detectable at a second location remote from the first location.
15. A method as claimed in any of the preceding claims, wherein each of the signal copies of a pair is disturbed by a detected disturbance.

16. A method as claimed in any of the preceding claims, wherein the signal copies of a pair travel in the same sense along the transmission link.

17. A method as claimed in any of the preceding claims, wherein the output signals
5 have an average phase-coherence time associated therewith of less than 1 pico seconds.

18. A method as claimed in claim 17, wherein the signal copies of a pair have a differential delay time associated therewith, the delay time being greater than the average phase-coherence time by a factor of at least 1000.

10

19. A method as claimed in any of the preceding claims wherein the transmission link includes an optical channel extending along a guide track, the guide track being arranged to guide the movement of a vehicle, the channel being arranged such that movement of the vehicle causes a disturbance along the optical channel.

15

20. A method as claimed in claim 19, wherein the path of the optical channel crosses the track at intervals.

21. A method as claimed in claim 19 or 20, wherein the guide track has the form of
20 one or more rails for guiding the movement of a train.

22. A apparatus for evaluating the position of a time-varying disturbance on a transmission link, the apparatus including: means for copying, at least in part, an output signal from a source, such that there is a pair of signal copies; means for transmitting the
25 signal copies onto the transmission link; means for receiving from the transmission link at least partially returned signal copies previously transmitted thereon; means for combining the received signal copies of a transmitted pair so as to produce a combination signal; and, monitoring means for monitoring the combinations signal as a function of time.

30 23. A apparatus as claimed in claim 22, wherein the monitoring means includes a display device for displaying the combination signals as a function of time.

24. A apparatus as claimed in claim 22 or claim 23, wherein delay means is provided for delaying the signal copies of a pair relative to one another.

35

25. A apparatus as claimed in claim 24, wherein the delay means is provided by an interferometer stage, the interferometer stage having first and second transmission legs and coupling means for coupling to or from the first and second legs, and wherein the means for copying output signals and the means for combining the received signal copies
5 are formed in common by the coupling means.

26. A monitoring station for monitoring a transmission link, the monitoring station having: a source for generating output signals; an interferometer stage for copying at least in part the output signals from the source such that for each output signal, there is a pair
10 of signal copies; an output for launching the signal copies onto the transmission link; and, a processor circuit; wherein the interferometer stage is arranged to receive signal copies returned by a process of distributed backscattering from the link and to combine the signal copies so as to produce an interference signal, and wherein the processor circuit is arranged to store the interference signal in association with an indication of a temporal
15 characteristic of the return signal.

27. A monitoring station as claimed in claim 26, wherein the interference signal is a time-distributed signal which varies with time, and wherein a temporal characteristic is the time variation of the return signal.
20

28. A monitoring station as claimed in claim 26 or claim 27, wherein the interference signal is a time-distributed signal, and the processor circuit is arranged to sample the interference signal at intervals, and to store the samples in association with a respective return time for each sample.

25

29. A monitoring station as claimed in any of claims 26 to 28, wherein the source is an optical pulse source.

30. A sensing system for sensing the position of a moving vehicle, the sensing
30 system having: a guide track for guiding the movement of the vehicle; an optical channel extending along the guide track; and, monitoring apparatus coupled to the optical channel, wherein the optical channel is mechanically coupled to the guide track such that movement of the vehicle causes a moving disturbance along the optical channel, the monitoring apparatus being configured to (i) detect a light signal from the optical channel
35 indicative of a the moving disturbance, (ii) evaluate at least one temporal characteristic of

the light signal, and (iii) in dependence on the evaluated temporal characteristic, determine an indication of the position of the moving disturbance along the channel so that the position of the vehicle along the track can be sensed.

- 5 31. A method of sensing the position of a vehicle moving along a guide track, wherein there is provided an optical channel extending along the guide track, and monitoring apparatus coupled to the optical channel, the optical channel being mechanically coupled to guide track such that movement of the vehicle causes a moving disturbance along the optical channel, the method including the steps of: (i) detecting a
10 light signal from the optical channel indicative of a the moving disturbance; (ii) evaluating at least one temporal characteristic of the light signal; (iii) in dependence on the evaluated temporal characteristic, determining an indication of the position of the moving disturbance along the channel; and (iv) inferring the position of the vehicle from the position of the disturbance along the optical channel.

15

32. A method of monitoring a transmission link to detect a physical disturbance of the link, the method including the steps of: copying, at least in part, an output signal from a source, such that there is a pair of signal copies; transmitting the signal copies onto a common communications link; receiving from the transmission link at least partially
20 reflected copies previously transmitted thereon; combining the received signal copies of a pair so as to produce a combination signal; monitoring the combination signal to detect a disturbance feature in the combination signal, from which disturbance feature the presence of a disturbance can be inferred; and, from a temporal characteristic in the combination signal, estimating the position of the disturbance on the communications link.

25